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PRACTICAL FORESTRY ON A SPRUCE TRACT IN MAINE.

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PRACTICAL FORESTRY ON A SPRUCE TRACT IN MAINE.

INTRODUCTION.

In this circular is embodied the six years' experience of the writer as forester in the employ of a large lumber and paper company of New England. The term "forester" is here used in rather a broad sense. With the understanding that his work was, as far as possible, to promote conservative cutting and the growth of young stuff, the writer went in, like any other employee, to make himself useful to the business.

THE TRACT.

The spruce-bearing portion of the Androscoggin Basin, within which the company's tract is situated, includes most of its upper half, extending easterly from the White Mountains across the Rangeley Lake region in Maine, and thence north to the Canada line. Its topography is uneven and sometimes very rough, with numerous mountains, some of which rise to more than 3,000 feet above sea level. The main streams are drivable, but a drawback in logging is the steepness of some of the slopes. Much of the region is too rough for bare-ground logging. Snow comes, as a rule, about the 1st of December, and is 3 or 4 feet deep by the 1st of March.

Red and white spruce are distributed over the region and reach a fine individual development. The higher mountains are covered with almost pure forests of spruce, and the swamps and flats are timbered largely with spruce and fir, while the slopes and ridges bear varying stands of spruce, fir, birches, maples, and beech. Throughout the region there is abundant reproduction. Cut-over mountain sides, if they remain unburned, come up densely to spruce and fir, and elsewhere reproduction as a rule is good.

The lands of the company, then, though varied in character, are valuable chiefly for the spruce timber standing upon them. The company, in 1898, owned about 300,000 acres, and its annual cut—in part, however, from other holdings—was 70,000,000 board feet. Part of this was sawed into lumber and the rest used for paper pulp. From the mills at Berlin Falls, N. H., the highest point on the Androscoggin River reached by railroad, operations of the company were scattered through the woods of the region to the sources of the river, 100 miles away. Driving employed a large force of men in the

spring, and logging, when at full volume in early winter, employed probably 500 horses and 1,500 men. At one point or another cutting was carried on throughout most of the year. The camps were supplied from several different directions and were loosely bound together by a system of roads and telephone lines.

CONDITIONS AT THE START.

In an established business of this kind forestry could occupy at the start only a secondary place. This fact was especially clear with regard to two important matters—the volume of the cut and the organization of the logging force.

The volume of the cut was determined by market and financial conditions, and it was approximately the same from year to year. All operations of the company had been accommodated to it, and this condition the forester could not expect to alter.

Almost as firmly intrenched was the personnel of the logging force. The men doing the actual labor of the woods were of the usual lumberman type, and in them no sudden improvement could be expected. In its woods foremen the company was, from the logging view point, decidedly strong, and in its employ were a number of very effective men who had risen from the ranks through their energy and capacity; but they were, on the other hand, from the forester's view point, possessed of very decided drawbacks. They were naturally suspicious of new ideas and methods and were apt to despise small things.

The position of the forester in these circumstances was not an easy one. Forestry had to be recognized as secondary, and the forester's work had to be done largely in indirect ways. To carry out systematically any scheme based upon his ideas was impossible, and all that could be done was to strike for one or two things at a time and to work them out on the ground as best he might.

WHAT WAS ACCOMPLISHED.

With these conditions at the start, the following improvements may be said to have been due directly to the application of practical forestry to the company's tract:

(1) Increased economy in utilizing the stock of timber standing on the land.

(2) A system of cutting adapted to the land, the timber, and the business organization, and at the same time directed toward the promotion of future growth.

(3) The heading off of a big insect depredation.

(4) A map system devised, and in large measure carried out, which renders it possible to handle a large land property with far more economy and effect than could otherwise be done.

Fire protection had been fairly well secured by the company for many years before the engagement of a forester.

ECONOMY AND WASTE.

The first thing that impressed the forester upon entering the service of the company was the great and needless waste in logging. Of the several causes to which this was due, the most important and the remediable one was that close thinking had seldom been put into this side of the work. Old logging bosses had often formed practice without regulation. Strange to say, too, the worst offenders were not the logging contractors, but the company's own men, and these often the most valued and the best. The amount of labor required to get them to pick up small items was truly surprising. This was due, however, to their training. For years they had been judged mainly by the cost of their logging. "Cheap logs, cheap logs," had been dinned into their ears until they could hardly recognize any other tune; and it consequently took two years of steady hammering before they could really believe that the company wanted them to go to extra expense to pick up inferior material.

Waste in logging occurred in the following forms: (1) High stumps; (2) large tops left in the woods; (3) the use of the ax instead of the saw; (4) trees cut and left in the woods; (5) dead or down trees which contained good lumber not taken; (6) merchantable logs used in building skidways, roads, and camps.

To secure complete economy it proved certain, in this case at least, that regular, frequent, and thorough inspection was the one indispensable thing. Supplementary to this, printed instructions were issued to foremen which covered the sources of waste just given; and where contractors were employed the question of waste was carefully dealt with in the contracts. Usually the contract specified that stumps should be cut as low as the swell of the roots, or within a specified distance from the soil; that when deep snow lay on the ground it should be shoveled from the base of the trees to be cut, or else cutting should cease entirely; that the saw should be used in place of the ax; and that lodged trees and merchantable timber used in skidways and elsewhere should finally be taken for lumber or pulp. Reform could not move too fast, however, or without clear understanding on the part of all concerned, for men might have been disgruntled and work thrown out of gear.

Greater difficulty was encountered in matters in which desired standards could not be so sharply specified. Windfalls and dead standing timber are common in the virgin spruce woods of New England, and come under this head. The trees are often defective, and are more expensive to haul than live timber, but with present lumber

prices it means a distinct loss to the owner if such material is left on the ground. At the expense of a good deal of labor thrown away in testing, this class of timber was carefully picked up. In just such a case as this, where expense has constantly to be balanced with availability at the mill, was shown the utility of inspection. A thoroughly posted man was on the ground every two or three weeks during the logging season to explain requirements, settle doubtful points, and keep things up to tone. That this paid for itself was perfectly evident. If ordinary logging was costing $4 per thousand, it might cost half as much more to pick up the windfalls and dry timber, a fact which told in the average cost of the whole cut. And yet at that figure there was a margin on even low-grade lumber, while much of the material gained was as good as the best. As a matter of fact, the rate of profit on all this class of stuff was larger than that on the main output of many other industries, while the amount saved the company would have made a handsome business for many lumbermen.

An idea of results of this system may be gathered from the following table, which shows for six logging camps the actual amount of merchantable timber cut and left on the ground. In order to ascertain what the waste was, the writer for two winters went systematically over all the roads cut from these six camps, noting every departure from the standard of economy prescribed. It will be seen that the total loss and waste in 15,600,000 feet cut was 250,000 feet, or 1.47 per cent. Much of this, too, was unavoidable. It would have cost more than the stuff was worth to get it. The gross gain from inspection alone, without reference to any written orders, is believed to have been at least 1,000,000 in 15,600,000 board feet, which, in a cut of 70,000,000 feet, would represent a stumpage value of $25,000.

TABLE 1.—*Waste in logging.*

Camp No.	Total cut.	Stumps and tops.	Logs cut and left.	Poles left.	Lodged trees.	Standing dry timber.	Down and uprooted trees.	Sure to blow down.	Total waste.	Percentage of cut.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	
1	2,000,000	.....	1,000	100	.....	500	6,300	4,200	12,100	0.6
2	2,400,000	11,600	2,300	1,400	200	6,500	10,000	7,500	39,500	1.7
3	3,400,000	35,000	5,400	6,000	6,000	3,500	27,000	17,100	100,000	3.0
4	3,400,000	1,400	1,900	2,000	1,100	1,000	10,600	4,000	22,000	0.7
5	2,500,000	30,500	2,200	5,500	2,000	4,200	10,300	6,000	60,700	2.3
6	1,900,000	3,000	100	300	1,200	3,000	4,600	2,800	15,000	0.8
Total	15,600,000	81,500	12,900	15,300	10,500	18,700	68,800	41,600	249,300	1.5

Thus the fuller utilization of material was not brought about in the office or by any other short and easy method, but by frequent and thorough inspection in the woods, by bringing the foremen up to time, and holding them in their turn to very careful oversight of their crews.

GENERAL MANAGEMENT.

In considering the advisability of conservative cutting the company had taken into consideration all factors for and against it, and had formulated in their own minds what they believed was the best policy to pursue in their logging work. Certain tracts where the fire risk was great, especially bordering railroads, they determined to cut clean. Land very expensive to operate they disposed of in the same way. Other tracts not seriously jeopardized by fire, and where drivable streams and the lay of the ground made lumbering fairly cheap, they determined to cut more lightly, with a view to a second crop, and perhaps later ones. This policy was the company's own, and to everyone qualified to judge it seemed then, as it seems now, a sound one.

The logging work over which the writer had regular and immediate oversight amounted to about 20,000,000 feet per year, and was scattered among ten camps, to cover which required a round trip of about 150 miles. Within this area conservative cutting was to be practiced, and in every way the work was to be put on the highest practicable plane. What conservative cutting meant under the circumstances was by no means an easy matter to determine. A general diameter limit was very far from solving the problem. Things had to be settled on the ground in accordance with the circumstances of each case. The general plan followed, as nearly as it can be put on paper, was this: The mountains and ridge tops were stripped of their softwood timber because of the risk in such situations from wind. The same was done in distant corners, and on very rough ground where a logging operation necessarily involved great expense. There will be no return to such places until the appearance of an entirely new crop sufficient to make a logging operation pay. In mixed stands of hardwoods and softwoods, on the other hand, the softwoods below a diameter of approximately 12 inches were left standing. This amounted ordinarily to perhaps 2,000 feet per acre. Bunches of timber composed chiefly of young growth, with no dead or down timber, were left intact.

Spruce growth on the lower ground presented the hardest problem. If large and in dense stand there was no doubt that it must be cut clean. On the other hand, shorter and smaller stuff, well rooted as it sometimes was, could be thinned out to any extent desired. In the medium stands, however, came the opportunity for nice judgment and knowledge of local conditions. To prevent windthrow strong strips and bunches were left, roads were kept at least 4 or 5 rods apart, and sometimes trees would be left standing which from every other point of view it was desirable to cut. Frequently a third or half of all the stand remained, so that a person who did not understand what was going on would consider it the slackest kind of cutting. But

that was the best that could be done unless we were ready to strip the country. Such cutting secured also the effect of thinning; not an ideal thinning, to be sure, but still of considerable practical effect.

Wind was, nearly everywhere, the big limiting and controlling factor. Spruce is a shallow-rooted tree and is therefore very liable to be thrown by wind. The Androscoggin country, too, is one most open to such loss. Virgin stands on mountains and ridge tops are frequently blown down, and in such places there is no safety whatever for thinned timber. It was poor business to leave stuff to blow down, for even if it went down in such quantities that the company could afford to pick it up, that would have been at increased expense. A system like that of the Black Forest, for instance, which, in spite of the skilled and detailed handling, yields on the average a fourth of the yearly product in windfalls, had it been put in operation here, would have condemned the whole system.

Such was the system finally settled on after a good deal of wear and tear, friction with logging bosses, experiment, and some mistakes involving appreciable loss. The ideal was nowhere achieved, but the main purposes of forestry, nevertheless, were carried out. This was done, moreover, without cost to the owners, because the big timber was taken out for as little or less cost per thousand than had the land been stripped. Further, enough was left, and in such shape and location that it would afford a reasonably cheap cut next time.

CREWS AND LOGGING METHODS.

Once a system of cutting had been decided upon, it became necessary for the forester to turn his attention to the actual work of getting the timber from the forest with as little injury as possible to the remaining stand.

Log hauling, except close to water, consisted of two parts—yarding or skidding and hauling on double sleds.

A yarding crew consisted usually, besides team and teamster, of 4 men, who, except for oversight by the foreman of the whole operation, worked by themselves. One man led off and made a road by cutting out trees and windfalls, filling up holes, and bridging brooks. Then followed the head chopper, ordinarily the man of most experience, who, with a man to help him, felled the trees, cut off the tops and limbs, and rolled or swung the log to where the team could pick it up. The fourth man trimmed the knots, barked the log if necessary, and helped to bind it to the sled. The men were chiefly French Canadians and immigrants from the British provinces, with some Americans and a sprinkling of men from the northern countries of Europe.

There is no standard length of saw log in New England, as in the State of New York, but the spruce mills saw a good deal of heavy

timber for framing, and in consequence desire long logs. Forty feet is a good sawing length, and a portion of the largest and straightest timber should be fifty feet or over. This meant that the logs were cut the mxaimum length that could be driven in the streams. Now, a spruce log two feet through at the butt and 40 feet long was heavy to handle. One horse could not drag it on ordinary ground, and the men could not handle it with any degree of carefulness.

In the virgin forests a double team and a sled from 4 to 5 feet wide was used for yarding. This type of rig and the length of the logs required a broad and comparatively straight road, put through regardless of consequences. The expense of swamping, too, made it hard to treat the country in the detail that seemed best for conservative logging. Local conditions had a large influence on the felling. Big trees standing near a road had to be let down close to its line in order that the logs might be easily loaded, and this frequently entailed sacrifices of small timber. If a tree stood away from the road the usual plan of the choppers was to fell the top across it, cut what stuff stood between the butt and the road, and roll the butt log in. Frequently this process meant the sacrifice of promising young stuff. This was the more true when deep snow lay on the ground, and small stuff had to be cut and laid crosswise under the logs to prevent them from burying. Thorough logging in thick stands left the country pretty nearly a desert. In good mixed stands it was found by trial that about a third of the young growth was destroyed by the process of lumbering.

BUNCH AND STRIPWISE CUTTING.

Conservative logging, under these circumstances, to be cheap and practical had to be largely stripwise cutting. Groups and lines of big trees were taken out and of necessity a large share of the undersized timber that stood among them. Between these strips were left. These consisted chiefly of undersized trees, but also frequently contained scattering trees of good size. No sound dead trees or windfalls were left. By these methods, of course, tree-by-tree selection was seldom possible.

LINES FOR IMPROVEMENT.

THROUGH PERSONNEL.

In any improvement in the logging organization the important influence to reach was clearly the foreman. He was in the best position to lay out the work as it came along—the man, therefore, who had to be trained and to whom directions should be issued. At best the forester could be on a job but once in a couple of weeks and therefore could guide the operations only in a general way.

But foremen had to be vastly sharpened up in their ideas about their duties. Many of the older men had been practically undisturbed in their sphere for years and had fallen into the habit of visiting their crews about once a day and spending the rest of the time, if they felt like it, in camp. For a new man to bring about a change in this matter was, of course, delicate work. The best weapon at hand was thorough inspection, which meant going over the work regularly and thoroughly, taking note of every item of waste, watching for stuff left standing that was likely to blow down, showing the man on the spot just where his work failed from the ideal, and leaving in the camp a written report—a duplicate of which was sent to the office—of just what was found. There was sometimes a surprisingly quick and striking result from this system.

LOCATION OF ROADS.

A factor which had much to do with the cutting of the timber was the location of the roads. When these had once been spotted out it was determined what was to be cut, and, if a thinking man located them, he could be of good service keeping them away from bunches of young timber. The spotting of yarding roads, therefore, was taken away from the choppers, whenever possible, and given to the foreman. The old system of road running was also modified. As few roads as possible were to be employed, so a greater number of branch roads were run, in modification of the old parallel system.

MARKING AND FELLING.

Marking the timber to be cut ahead of the operations was, after a fair trial, found to be ineffective and unsatisfactory. The foremen would take no interest in it themselves, and nothing else made the old loggers so angry or so destroyed their interest in their work. Further, it was found that in the company's timber and under the existing conditions, marking could hardly be done to advantage ahead of the operations, especially in advance of the location of the roads. The wind question, for one thing, was too fine a one. A man could not tell how the resulting stand was going to look until it was actually opened up.

Moreover, with an active, interested foreman, one who understood what was wanted in the way of cutting, marking the timber was not essential to secure a very fair result. A foreman who was with his crews several times a day could get just about such trees cut as he wanted, and in that way, also, he could see how the cutting looked as it went along. An inspection of each road before the choppers left it was a regular feature of the foreman's duties. If any defective trees had been left, or any that he thought would blow down, it was not too late to get them out.

There were some tricks in felling, designed to save small growth, which the men could learn and apply. Sometimes a big tree could be let down equally well in two or three directions, and the chopper, if he would notice in which direction promising young growth stood, could save it. Occasionally there would be a chopper among the crews who could be got to do that. Another good and inexpensive plan was to fell the heavy-crowned spruce directly into the roads, where they would do no damage. If they lay at an angle with the road they could be dragged in by the team instead of being rolled over the young growth. If the log in this position made a hard pull, they took it first and made up the load below. Sometimes a more distant log might be dragged out with a chain, and the cost of this labor was often more than offset by the saving in the cost of swamping.

Lastly, much could be done for the woods in every direction—in economy, in effective thinning, and in favoring the resulting stand, by starting operations early and stopping the cutting work in January, before the advent of deep snow. A foot of snow ordinarily makes the best and cheapest logging, but deep snow impedes good work.

The gains made by these means may look to be of small consequence, like nibbling around the edges of the matter instead of striking at once for its core. But the measures outlined, when persistently carried out, had appreciable effect on the condition in which land was left and on its consequent value. Moreover, whatever was accomplished by these means was without a dollar of cost to the owners of the land. The future of their business was a little more secure and their immediate profits were no less.

No statement of the gain expected from the policy pursued will be given here. It seems sufficient to state that the company feels reasonably secure and satisfied.

CONTRACT LOGGING.

When logging was done by contract, the clauses under which careful and conservative cutting could best be secured were as follows:

The contractor agrees and contracts with the company to cut, haul, and deliver into ——— River all the spruce and fir timber of description given below in the ——— Valley. The timber to be hauled at the rate of 2 to 2½ million feet a year, and the bounds of the valley to be determined by a spotted line run on the height of land by the company's inspector.

All spruce and fir trees over 12 inches in diameter breasthigh shall be cut, but no trees under that size unless in the necessities of hauling contract timber. But this rule may be varied by the company with a view to leaving the land in good growing condition. To this end the contractor agrees to cut the land clean or to refrain entirely from cutting where directed to do so by the company's inspector.

Windfalls that are sound shall be hauled, and all standing dry timber that is suitable for boards. Such dry timber shall not be discounted for sap rot but shall be scaled like green timber.

The contractor in laying out and cutting roads, in felling, and in all other operations, shall use all reasonable care in protecting from damage all spruce and fir trees that are smaller than contract timber. To this end he shall instruct his employees and give them diligent supervision. When trees under contract size are broken or cut down of necessity, they shall be hauled, down to the size of 5 inches in diameter at the top and 16 feet long.

The timber shall be sawed down, and the saw shall be used in cutting off logs except the top cut.

All trees shall be cut as near the ground as the swell of the roots admit, the snow being removed, if necessary, to effect this result.

Trees shall be run up to 5 inches in the top.

All fir logs shall be cut sound at both ends.

No logs more than 40 feet long shall be hauled. Crooked logs that are longer than that shall be cut in the crook. From straight trees over 40 feet long and under 52 a 12-foot top shall be taken; all over that shall be cut with a butt log 40 feet long.

No merchantable spruce shall be used for camp buildings or for firewood. No spruce or fir trees shall be used for roads, bridges, bedding, skids, slides, or other purposes when other material is to be obtained. When so used they shall, if of merchantable size, be hauled in.

For all trees left lodged, for all logs left in the woods, for all waste in stump and top, for all merchantable timber left in yards, roads, or bridges, the contractor agrees to pay at the rate of ——— dollars per thousand.

Any differences of opinion as to the operations carried on under this contract that can not be adjusted by the parties to it shall be adjusted by ——— ———, whose decision shall be binding and conclusive upon them.

DESTRUCTIVE INSECTS CHECKED.

At the time the writer first entered the upper Androscoggin basin, the country south of the Rangeley lakes was practically free from insect depredations. North of the lake system, however, damage in many places was severe. The best field for insects was in the virgin timber, and much of great value was either involved or threatened. The insect which caused the damage was a small, black beetle that killed the trees by cutting channels in the inner bark. Ordinarily the insects spread from one tree to others in its neighborhood, and thus clumps of dead or infected timber would be scattered over a valley. It was only occasionally that young broods spread far from their base. This was clearly shown by the fact that bodies of timber which were separated from the infested places by areas of cut-over lands had escaped attack. Even the width of Parmachenee Lake had long proved an effective barrier, though the insects finally attacked the fine timber on its western shore.

The chief measure of relief[a] was plain—to cut and drive the dead and infested timber, in order both to save the lumber and to drown the beetles. The company, of course, could not send crews over its vast holdings to search for small clumps of dead and infested trees;

[a] Recommended in Bulletin 28, new series, Bureau of Entomology, U. S. Department of Agriculture.

indeed such strenuous measures did not appear necessary. Certain things could be done, however, which were both profitable and practicable. These were: (1) To at once direct the regular logging operations into the heavily infested valleys, taking crews when necessary from those free of insects; (2) to locate in each valley that was being logged, the stands of insect-killed timber, and, when they were within reach, to cut them ahead of the green timber; (3) wherever it would pay, to begin special operations to get out the dead timber, with such other material as it would be necessary to take with it.

To carry out these measures, however, required persistence and great labor. The company was very cautious about changing the principles which had guided its operations, and when its consent to a change was secured came the work of carrying it out on the ground.

Yet the remedial work indicated was in large measure carried out, and the dead and infested timber was put through the mill, though the work was not done with either the promptness or the thoroughness that would have been desirable. However, much of value to the company and to the region was accomplished. Much valuable timber was rescued from decay, and insect depredations were reduced to insignificant proportions. What this saved the company is very hard to estimate. Certainly it was more than $100,000. But whatever the saving, the credit for it must lie with the application of forestry.

To-day there is little danger from insects on the tract. The larger colonies of beetles were taken out by the logging, and the woodpeckers and other enemies of the insects keep the lessened numbers in check. Moreover, the region has learned and digested an important lesson. Probably twenty woodsmen understand thoroughly the work of the beetle in all its practical bearings. From now on they will be on the watch, and serious trouble, if it should appear, will not escape them. It is safe to say that if the tract remains under continuous management, no serious damage from this source will ever occur again.

TIMBERLAND MAPS.

One of the greatest needs of the company was an adequate system of maps. Thorough first-hand knowledge of its vast holdings was too much for one man to acquire and retain. Spread out as they were, over hundreds of miles of territory, the most efficient management was necessary if things were to be kept moving, without loss of time or materials.

The whole extent of the timber resources of a property must be really grasped and subjected to intelligent control. There is such a thing as handling a country to good or to bad advantage from the point

of view of timber resources. A knowledge of the health of the timber in different parts of a property will tell immensely in the profit reaped. A tract may be caught for logging in the pink of condition, or it may be allowed to stand through a period of decline until a large proportion of its value has been destroyed. This question of "ripeness" has no less influence on profit than the market timeliness of operation.

There is also great variety of circumstance which must be clearly known if logging operations are to be conducted in the most effective way. Such points are the size of the various valleys and the amount of timber in them, the steepness of slopes and the character of the bottom as affecting logging, the chances there may be for roads and the advantages and disadvantages of these as regards grade, cost, and liability to overflow, the capacity of landing ground, facilities for driving, and the quantity that may be driven out of streams. All these and many other points must be taken into account if the most economical operation is to be secured. Accurate, systematic knowledge on all these points pays over and over again in the saving on poorly directed labor.

In the business of the Berlin Mills Company, at any rate, full and accurate maps have proved their serviceability. They have been used to locate camps and roads, to let contracts by, to plan operations of all kinds. It took a little time to learn how to use this system, but those who have persisted so far as to realize its benefits would not now part with it for several times its cost.

The lands of the company lay for the most part in townships that had never been subdivided. It was first settled that these should be divided into mile squares, a system of survey that has been found very serviceable for the help it gives in estimating timber and in laying out roads. This was work for the compass and chain. Into the framework so obtained the detail features of the country could readily be put by one man working alone, using the method of compass and pacing. The examination of the timber could be done in connection with this, and largely at the same time.

The next essential was to construct a contour map. Such a map looks very intricate to the uninitiated, but in reality its production was not a difficult or costly matter. Since the controlling factor was cost, the aneroid barometer was the instrument chiefly used in the work. By the methods employed, the topography was obtained at the same time that the man did the surveying and cruising.

The facts regarding a timber township were divided into two classes and represented on two sheets. One sheet contained permanent features, such as property lines and lines of subdivision, permanent roads, waters, and the contours. The other embodied facts

regarding the timber. These included the character of the timber and estimates of stand. Camps and supply roads were, of course, located. These sheets were drawn on tracing linen, so that one may be laid over the other and the topography and the timber seen in direct relation.

In addition, the map system was supplemented by topographic models, which showed in miniature the land just as it lay. These were a great satisfaction to the company, and were clearly understood by strangers and lumbermen, where contour maps might not have been.

As to cost, the whole operation, renewal of outside boundaries, division into mile squares, timber examination, and topographical mapping—the whole represented in model and maps—was carried out for less than $1,500 per township. A good deal more might, of course, have been spent, and in easier or less valuable country a sufficiently good result might have been obtained for less.

The map system, supplemented as it was by a man to map in the cuttings, renew lines, and keep watch of the timber, was of benefit to the company in the following ways:

(1) Operations could be planned and largely controlled from a central point. The cut could be located for years ahead, and with full consideration for the most economical driving and hauling of supplies.

(2) The location of all roads, whether logging roads or supply roads, was greatly facilitated. Exploring was saved and distances were accurately known.

(3) Great saving in the aggregate was effected through the detection of small losses such as windfall and insect depredation, and by knowledge of the location of bodies of unhealthy timber.

(4) Information about the tract could be preserved in permanent form. Many old lumbermen or cruisers possessed knowledge of the holdings which would have been lost when they died or stepped out, unless maps were at hand.

(5) Working knowledge of the territory could be gained by a new manager within a year, when otherwise he might be in the hands of his employees for a long time.

(6) The company could show its stockholders, investors, and directors just what property it was possessed of.

Approved:

JAMES WILSON, *Secretary.*

WASHINGTON, D. C., *October 11, 1907.*

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